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Spending on Household Energy Relative to Household Income in United States: A summary of Data in the Residential Energy Consumption Surveys, 1993-2015

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Abstract

This white paper summarizes calculations for United States' household spending energy as a fraction of household income. It uses data from the Energy Information Administration Residential Energy Consumption Surveys (RECS) for the years 1993, 1997, 2001, 2009, and 2015. The calculations are displayed in tables and figures to facilitate exploration of the data in multiple formats and support research and communication on "energy burdened" households. "Energy burdened" households are defined as those that spend a disproportionate percentage of income on energy. This report does not attempt to define a specific threshold percentage to define energy burden, but provides data and specific calculations at different percentages (up to 10% of income spent on household energy) to allow readers to discuss what percentage might indicate a harm to livelihood due to income becoming a constraint for paying for proper energy services within a household. The ratio of the total household income spent on energy varies across regions of the U.S., with the Pacific and Mountain regions reporting lower values than the central and eastern regions of the U.S. Possibly due to changes in survey methodologies (sample sizes and assumed income brackets) the 2009 and 2015 RECS show significantly different trends than the other years. The 2009 data indicate higher energy spending (14-20% of households spending >10% of income on household energy), and this could have been a result of lower incomes following the Great Recession. The 2015 data indicate significantly lower energy spending (4-10% of households spending >10% of income on household energy). The survey years 1993, 1997, and 2001 indicate 8-18% of households spending >10% of income on household energy.

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1. Introduction

According to the U.S. Energy Information Administration (EIA) study of data from 2015, 31% of the population in the U.S. households struggle with paying energy bills to keep their homes warm and cool [EIA, 2020]. The EIA study also states that 20% of people in the U.S. reduce or forgo necessities of food and medicine to pay an energy bill. These conclusions come from analyzing data from the 2015 survey year of the EIA's Residential Energy Consumption Survey (RECS). The RECS has been performed since 1978 for every 1-6 years, and extensive data sets exist for 1993, 1997, 2001, 2005, 2009, and 2015. This paper analyzes data on household energy expenditures relative to household income for five of these last six survey years. We do not present data from the 2005 RECS due to lack of income data in that data set.

The goals of the analyses of this paper are to 1) encourage knowledge production in the field of energy poverty as a pressing critical research topic in the U.S., 2) develop research tools to spur public interest in social justice issues related to the reliability and affordability of energy resources, and 3) facilitate dialogue and intellectual engagement in the context of the role of energy in individual and societal livelihood. In our study, we use the EIA RECS data to calculate the percentage of household income spent on household energy, or the so-called "energy burden." The purpose of this study is to summarize the pattern of energy burden across years and regions of the U.S. while including uncertainty in the calculations that derive from lack of precise knowledge of household income. We perform our analysis using the open-source programming software R, and the Section "Data and Code Files" at the end of this report points to the author's website for access to the data and codes.

2. Methods

There are five different microdata files for each RECS survey cycle for our study, 1993, 1997, 2001, 2009, and 2015. We cannot perform our calculations for the 2005 RECS data because household income is reported as "NA." Therefore, five datasets excluding 2005 were adopted for our study.

The main body of this report summarize the methods and high level findings. More extensive calculated results indicating the fraction of household incomes spent on household energy are in the Appendices as follows:

- Appendix A: Figures showing each Census Division and U.S. for a given Year (assuming incomes at midpoint of income brackets)
- Appendix B: Figures showing each year for a given Census Division and U.S. (assuming incomes at midpoint of income brackets)
- Appendix B.upper: Figures showing each year for a given Census Division and U.S. (assuming incomes at Upper End of RECS income brackets)
- Appendix B.lower: Figures showing each year for a given Census Division and U.S. (assuming incomes at Lower End of RECS income brackets)
- Appendix C1: Figures showing each year for a given Census Division and U.S. (assuming incomes at Middle End of RECS income brackets)
- Appendix C2: Figures showing each year for a given Census Division and U.S. (plotting a range assuming incomes at Lower-Middle-Upper ends of RECS income brackets)

2.1 Data Use for Calculations

This section summarizes the data within the EIA RECS that inform the calculation of expenditures on household energy divided by household income. The data items within RECS are listed in all caps using the nomenclature of the RECS data.

2.1.1 Annual spending on different forms of household energy

The RECS reports expenditures for four types of energy carriers, or fuel:

- DOLLEREL: Total annual electricity spending, in dollars (1993, 1997, 2001, 2009, 2015)
- DOLLARNG: Total annual natural gas spending, in dollars (1993, 1997, 2001, 2009, 2015)
- DOLLARLP: Total annual propane spending, in dollars (1993, 1997, 2001, 2009, 2015)
- DOLLARFO: Total annual fuel oil/kerosene spending, in dollars (1993, 1997, 2001, 2009, 2015)

The total energy spending on household are summed up from these four fuels of electricity (EL), natural gas (NG), liquid petroleum gases or propane (LP), and fuel oil (FO). The assumptions and methods for calculating annual household expenditures on energy for a housing unit during 2015, the RECS 2015 documentation states that "The annual consumption was simply the sum of the bills that were entirely within 2015 and any prorated bills. Because electricity and natural gas are billed at regular intervals, if an extended time period had no reported data, EIA assumed that

the energy billing data were missing for that period." However, unlike electricity and natural gas, delivery of propane and fuel oil has a different recording characteristic due to the irregular record. RECS 2015 documentation states that "To annualize a housing unit's bulk fuel consumption, EIA chose the subset of deliveries that included as much of 2015 as possible, while coming as close as possible to 365 days. In some cases, this subset included all of 2015, plus some extra days in 2014 or 2016. In other cases, this subset could have excluded some days at the beginning or end of the calendar year 2015. In either case, the total consumption was summed for the time period that was included in the chosen deliveries. This sum was prorated to match the calendar year 2015."

2.1.2 DIVISION: Census Division

The RECS data have indicators designating the U.S. Census Division (DIVISION) in which the survey occurred. There are 9 Census Divisions from 1993 to 2001, however, the number of divisions increased to 10 for the 2009 and 2015 data as the Mountain division was separated into two: Mountain North and Mountain South (see Table 1). The RECS 2009 survey states why this changes was made: "Because energy usage differs substantially within the division, since the 2009 RECS EIA further divides the Mountain Division into Mountain South (which includes Arizona, New Mexico, and Nevada) and Mountain North (which includes Colorado, Idaho, Montana, Utah, and Wyoming)."

- Census Divisions for 1993, 1997, 2001:

New England (NW), Middle Atlantic (MA), East North Central (ENC), West North Central (WNC), South Atlantic (SA), East South Central (ESC), West South Central (WSC), Mountain, Pacific

- Census Divisions for 2009, 2015:

New England(NW), Middle Atlantic(MA), East North Central(ENC), West North Central(WNC), South Atlantic(SA), East South Central(ESC), West South Central(WSC), Mountain North(MN), Mountain South(MS), Pacific

Table 1. The U.S. Census divisions (DIVISION) as used to designate RECS data per regions of the U.S. (EIA, 2015)

Region	Division	States
Northeast	New England	Connecticut, Maine, Massachusetts, New Hampshire, Vermont, and Rhode Island
	Middle Atlantic	New Jersey, New York, and Pennsylvania
Midwest	East North Central	Illinois, Indiana, Michigan, Ohio, and Wisconsin
	West North Central	Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota
South	South Atlantic	Delaware, the District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia
	East South Central	Alabama, Kentucky, Mississippi, and Tennessee
	West South Central	Arkansas, Louisiana, Oklahoma, and Texas
West	Mountain*	Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming
	Pacific	Alaska, California, Hawaii, Oregon, and Washington

*Mountain South: Arizona, Nevada, and New Mexico
Mountain North: Colorado, Idaho, Montana, Utah, and Wyoming

2.1.3 NWEIGHT: the final sampling weight

Table 2 notes the sample size, per DIVISION, for each RECS. Each household survey is given a weight, NWEIGHT that indicates the number of total households assumed to be represented by each survey. For example, for a given survey of a single household, if NWEIGHT 10,000, the number of households assumed represented by that sample is 10,000.

Table 2. The RECS sample size per year and U.S. Census Division

	Sampling size for each year				
U.S. Census Division (DIVISION)	2015	2009	2001	1997	1993
1. New England	253	938	396	490	567
2. Middle Atlantic	541	1328	691	842	964
3. East North Central	836	1150	681	783	970
4. West North Central	491	1693	366	451	571
5. South Atlantic	1058	2246	626	871	1232
6. East South Central	372	614	409	527	556
7. West South Central	580	1230	454	581	706
8. Mountain	NA	NA	407	466	550
9. Mountain North	228	445	NA	NA	NA
10. Mountain South	242	367	NA	NA	NA
11 Pacific	1085	2072	792	889	995
TOTAL	5,686	12,083	4,822	5,900	7,111

2.1.4 MONEYPY: Annual gross household income

As shown in Table 3-Table 6, each year has a different income range and categories in each year. There are 25 income brackets used in 1993 and 1997, 10 income brackets in 2001, 24 income brackets in 2009, and 8 income brackets in 2015. These differences pose difficulties in comparing data across survey years.

Table 3. The definitions of the income brackets used in the EIA RECS from 1993 and 1997.

1993 and 1997						
MONEYPY	Income range			Middle Point	Upper bounds	Lower bounds
1		Less than	$3,000	$3,000	$3,000	$3,000
2	$3,000	-	$3,999	$3,500	$3,999	$3,000
3	$4,000	-	$4,999	$4,500	$4,999	$4,000
4	$5,000	-	$5,999	$5,500	$5,999	$5,000
5	$6,000	-	$7,499	$6,750	$7,499	$6,000
6	$7,500	-	$8,999	$8,250	$8,999	$7,500
7	$9,000	-	$9,999	$9,500	$9,999	$9,000
8	$10,000	-	$10,999	$10,500	$10,999	$10,000
9	$11,000	-	$12,499	$11,750	$12,499	$11,000
10	$12,500	-	$13,999	$13,250	$13,999	$12,500
11	$14,000	-	$14,999	$14,500	$14,999	$14,000
12	$15,000	-	$17,499	$16,250	$17,499	$15,000
13	$17,500	-	$19,999	$18,750	$19,999	$17,500
14	$20,000	-	$22,499	$21,250	$22,499	$20,000
15	$22,500	-	$24,999	$23,750	$24,999	$22,500
16	$25,000	-	$27,499	$26,250	$27,499	$25,000
17	$27,500	-	$29,999	$28,750	$29,999	$27,500
18	$30,000	-	$32,499	$31,250	$32,499	$30,000
19	$32,500	-	$34,999	$33,750	$34,999	$32,500
20	$35,000	-	$39,999	$37,500	$39,999	$35,000
21	$40,000	-	$44,999	$42,500	$44,999	$40,000
22	$45,000	-	$49,999	$47,500	$49,999	$45,000
23	$50,000	-	$74,999	$62,500	$74,999	$50,000
24	$75,000	-	$99,999	$87,500	$99,999	$75,000
25	$100,000	or more		$100,000	100000	$100,000

Table 4. The definitions of the income brackets used in the EIA RECS from 2001.

2001						
MONEYPY	Income range			Middle Point	Upper bounds	Lower bounds
1		Less than	$5,000	$5,000	$5,000	$5,000
2	$5,000	-	$9,999	$7,500	$9,999	$5,000
3	$10,000	-	$14,999	$12,500	$14,999	$10,000
4	$15,000	-	$19,999	$17,500	$19,999	$15,000
5	$20,000	-	$29,999	$25,000	$29,999	$20,000
6	$30,000	-	$39,999	$35,000	$39,999	$30,000
7	$40,000	-	$49,999	$45,000	$49,999	$40,000
8	$50,000	-	$74,999	$62,500	$74,999	$50,000
9	$75,000	-	$99,999	$87,500	$99,999	$75,000
10	$100,000	or more		$100,000	$100,000	$100,000

Table 5. The definitions of the income brackets used in the EIA RECS from 2009.

2009						
MONEYPY	Income range			Middle Point	Upper bounds	Lower bounds
1		Less than	$2,500	$2,500	$2,500	$2,500
2	$2,500	-	$4,999	$3,750	$4,999	$2,500
3	$5,000	-	$7,499	$6,250	$7,499	$5,000
4	$7,500	-	$9,999	$8,750	$9,999	$7,500
5	$10,000	-	$14,999	$12,500	$14,999	$10,000
6	$15,000	-	$19,999	$17,500	$19,999	$15,000
7	$20,000	-	$24,999	$22,500	$24,999	$20,000
8	$25,000	-	$29,999	$27,500	$29,999	$25,000
9	$30,000	-	$34,999	$32,500	$34,999	$30,000
10	$35,000	-	$39,999	$37,500	$39,999	$35,000
11	$40,000	-	$44,999	$42,500	$44,999	$40,000
12	$45,000	-	$49,999	$47,500	$49,999	$45,000
13	$50,000	-	$54,999	$52,500	$54,999	$50,000
14	$55,000	-	$59,999	$57,500	$59,999	$55,000
15	$60,000	-	$64,999	$62,500	$64,999	$60,000
16	$65,000	-	$69,999	$67,500	$69,999	$65,000
17	$70,000	-	$74,999	$72,500	$74,999	$70,000
18	$75,000	-	$79,999	$77,500	$79,999	$75,000
19	$80,000	-	$84,999	$82,500	$84,999	$80,000
20	$85,000	-	$89,999	$87,500	$89,999	$85,000
21	$90,000	-	$94,999	$92,500	$94,999	$90,000
22	$95,000	-	$99,999	$97,500	$99,999	$95,000
23	$100,000	-	$119,999	$110,000	$119,999	$100,000
24	$120,000	or more		$120,000	$120,000	$120,000

Table 6. The definitions of the income brackets used in the EIA RECS from 2015.

2015						
MONEYPY	Income range			Middle Point	Upper bounds	Lower bounds
1		Less than	$20,000	$20,000	$20,000	$20,000
2	$20,000	-	$39,999	$30,000	$39,999	$20,000
3	$40,000	-	$59,999	$50,000	$59,999	$40,000
4	$60,000	-	$79,999	$70,000	$79,999	$60,000
5	$80,000	-	$99,999	$90,000	$99,999	$80,000
6	$100,000	-	$119,999	$110,000	$119,999	$100,000
7	$120,000	-	$139,999	$130,000	$139,999	$120,000
8	$140,000	or more		$140,000	$140,000	$140,000

2-2. Description of Data for Calculations

2.2.1 Assumption for Household Income

Because there is a range of income within each income bracket (Table 3-Table 6) for each RECS, we perform calculations assuming three different incomes: the midpoint of each income bracket, the upper income bound, and the lower income bound. This provides some level of sensitivity analysis of how results could differ based on uncertainties in incomes.

2.2.2 Total Household Energy Spending in dollars

Our main calculation divides total spending on household energy by household income (MONEYPY):

- Total spending on household energy (dollars) = DOLLAREL + DOLLARNG + DOLLARLP + DOLLARFO
- The fraction of household income spent on household energy = Total spending on household energy / MONEYPY
- Total number of households in a region = sum of all NWEIGHT for that region

2-3. Special Notes on EIA Methods

2.3.1 The RECS is conducted in two steps as below.

Step one: “Phase one is a multi-stage sampled Household Survey that collects energy-related characteristics and usage patterns from a nationally representative sample of housing units.”

Step two: "the Energy Supplier Survey (ESS), which collects billing data for responding households from their utility suppliers to allow EIA to estimate energy consumption and expenditures."

As Figure-1 shows "Timeline of EIA's 2015 RECS," "the ESS collects data on how much electricity, natural gas, propane/LPG, fuel oil, and kerosene were consumed in the sampled housing units during the reference year collecting the data on actual dollar amounts spent on these energy sources."

2.3.2 Notes on Differences between the 2015 and 2009 RECS versus earlier RECS years

- Sampling error/uncertainty

Sample sizes vary across RECS years. In particular the sample size in 2009 RECS was larger than other years. For example, RECS 2009 surveyed 12,083 respondents, but the 2015 RECS had less than half the size at 5,686 respondents. Thus, we can expect a higher standard error for 2015 relative to 2009.

- A new sample frame development methodology for 2015

The 2015 RECS used different sampling as stated: "The Census Bureau's Public Use Microdata Areas (PUMAs) were used instead of counties (used in previous RECS surveys) in the first stage of the multi-stage area probability design. This change reduced unequal weighting effects and also reduced the sampling variability in the first stage by using energy data from the Census Bureau on PUMAs. In the second stage of sampling, Census Block Groups were used instead of Census Blocks (used in the previous RECS) to reduce clustering and possible intra-class correlations."

- New survey modes for the Household survey in 2015

"Prior to the 2015 RECS, all iterations of the study were conducted entirely through in-person interviews with trained interviewers at the sampled households. For the 2015 RECS Household Survey, 5,686 questionnaires were completed using a combination of three modes: in-person computer-assisted personal interviews (CAPI), paper questionnaires sent through the mail, and web questionnaires accessed by a URL and password sent through the mail." Due to this relatively major change in surveying, this could be the main reason why household spending on energy was generally reported lower across all regions of the U.S. in 2015 compared to previous RECS.

2.3.3 Example energy use across RECS sample

Not all households consume each type of energy carrier. Table 7 shows the number of respondents, per Census Division number, that responded as having consumed each of the four types of energy carriers within the 2015 RECS. Given the weights (NWEIGHT) applied to each sample, the number of households that consume each energy carrier in each Census Division are shown in Table 8.

Table 7. Sample size for each energy and each division for RECS 2015 DIVISION

Census DIVISION	Sampling size for each energy carrier and each division for 2015				
	EL	NG	LPG	FO	TOTAL
1. New England	253	102	66	117	253
2. Middle Atlantic	541	354	60	108	541
3. East North Central	836	629	62	8	836
4. West North Central	491	346	62	3	491
5. South Atlantic	1,058	355	106	42	1,058
6. East South Central	372	133	56	4	372
7. West South Central	580	274	54	1	580
8. Mountain North	228	184	17	-	228
9. Mountain South	242	153	18	-	242
10. Pacific	1,085	772	72	11	1,085
TOTAL	5,686	3,302	573	294	5,686

Table 8. Estimated number of households consuming each type of energy carrier within each Census Division, for RECS 2015.

DIVISION	Estimated population for each energy and each division for 2015				
	EL	NG	LPG	FO	TOTAL
1. New England	5,628,844	2,485,867	1,348,698	2,422,006	5,628,844
2. Middle Atlantic	15,377,694	10,928,969	1,356,735	2,982,404	15,377,694
3. East North Central	18,094,391	13,844,775	1,267,234	174,127	18,094,391
4. West North Central	8,277,344	5,808,876	1,033,754	41,455	8,277,344
5. South Atlantic	23,474,851	7,788,693	2,366,998	1,024,853	23,474,851
6. East South Central	7,197,189	2,529,892	1,058,476	63,942	7,197,189
7. West South Central	13,769,934	6,407,871	1,134,845	20,313	13,769,934
8. Mountain North	4,246,877	3,434,756	251,811	-	4,246,877
9. Mountain South	4,266,870	2,518,809	557,361	-	4,266,870
10 . Pacific	17,874,256	12,853,045	1,205,338	170,129	17,874,256
TOTAL	118,208,250	68,601,553	11,581,250	6,899,230	118,208,250

3. Example Calculation of Percentage of Household Income Spent on Household Energy

This section presents data (Table 9) and examples for calculating the metric of energy poverty as the fraction (or percentage) of household income that is spent on household energy. These calculations are repeated for all RECS data and summarized for each Census Division in different forms in the Appendices.

Consider the following example calculation as "Example-1" in Table 9. Each survey respondent is assigned a household ID (HHID) number. The responded with HHID = 1471 is listed with MONEYPY = 22 that corresponds to an income bracket from $45,000 to $49,999. Since we don't know the exact household income, we perform three calculations using the lower bound for the income as $45,000, the midpoint income as $47,500, and the upper income bound as $49,999.

Table 9 displays two other calculations. "Example-2" is for the respondent with HHID = 1472 with MONEYPY = 25, that represents the highest income bracket for the survey of $100,000 or more. Because there is no income bracket, we only perform the calculation using an income of $100,000 (e.g., spending on household energy as a percentage of income can only be lower than the calculated value). "Example-3" is for the respondent with HHID = 1473 with MONEYPY = 1 that represents the lowest income bracket for the survey of $3,000 or less. Therefore, since there is no income bracket, we only perform the calculation using the upper bound income of $3,000 (e.g., spending on household energy as a percentage of income can only be higher than the calculated value).

Table 9. RECS 1993 example data and individual calculations of the percentage of household income spent on household energy.

1993 RECS	Unit	Example-1	Example-2	Example-3	U.S. Totals
HHID	-	1471	1472	1473	-
MONEYPY	-	22	25	1	
Income bracket Upper bound Midpoint Lower bound	$	 49,999 47,500 45,000	 100,000 100,000 100,000	 3,000 3,000 3,000	See Table 3
Number of Households (NWEIGHT at HHID)	-	5,492	21,335	10,675	96.6 million
DIVISION	-	3 (ENC)	9 (Pacific)	7 (WSC)	∑ DIVISION
Sum of Household Income	$	275 261 247 million	2,134 2,134 2,134 million	32 32 32 million	$\sum_{i=1}^{25}(MONEYPY) \times NWEIGT$
Electricity	$	327	1820	614	81.1 billion
Natural Gas	$	244	692	356	32.0 billion
Fuel Oil	$	0	0	0	6.6 billion
LPG	$	0	0	0	3.8 billion
Sum of Energy spending in surveyed Household	$	571	2521	970	123.5 billion
Percentage of total household income on energy (if using upper bound, midpoint, and lower bound incomes)	%	1.1 1.2 1.3	2.5 2.5 2.5	32 32 32	Calculated as a distribution of the number of households spending a certain fraction of income on household energy

4. Results

In this section we summarize some high level results for the distribution of household spending on energy as a fraction of household income for overall U.S. households as well as within each Census Division. We present the same results in both figures and tables to enable more than one way to explore the results.

Figure 1 shows results from each of the five RECS where each line represents one year's survey. The curves are constructed by calculating the fraction of household income spent on household energy from each respondent, and then weighting that response by its NWEIGHT to scale it to all households in the U.S. The results are then ordered from highest (left) to lowest (right) spending as a fraction of income. Figures 2 and 3 show the same data, except we assume different income levels for the calculation as discussed in Sections 2 and 3. The results in Figure 2 use the household incomes that reside at the ***upper*** bound (level) of each income bracket, and the results in Figure 3 use the household incomes that reside at the ***lower*** bound (level) of each income bracket.

One takeaway from Figures 1-3 is that energy spending per income is lowest for the 2015 RECS and highest for the 2009 RECS. All other years have very similar distributions between those of 2015 and 2009. This report does not fully explore why the 2009 and 2015 results are so different than the other years, but Section 2.3 highlights some changes in the EIA's survey methodology that likely form the majority of the explanation. Full exploration is left for future work, but Figure 4 provides a hint as to the effect of the choice of income brackets in the 2015 RECS.

The definition of the lowest income in RECS 2015 is <$20,000. This is a much higher threshold than previous years in which $5,000 was the highest previous threshold defining the lowest income bracket. Figure 4 displays the cumulative number of U.S. households versus the cumulative U.S. household income normalized by the total income of all U.S. households. The data are ordered from left to right where the leftmost data are the lowest income households and the right most points are the highest income households. Looking at the 10% of poorest households, the 2015 RECS data clearly show a different pattern and lower resolution (due to the straight segments). In Figure 4 a steeper slope means that income is increasing quickly as each additional household is considered. A shallower slope means that income is increasing quickly in very few numbers of households (e.g., if one household had an income of 10% of all U.S. household income, that would represent a near horizontal line with a width of 0.1). If these curves were straight lines, it would mean that each household has exactly the same income. Thus, the 2015 data, due to such a high assumed threshold for the lowest income bracket, are clearly underestimating the number of households at low incomes relative to the other survey years.

The rest of this section displays and describes the data in different formats. Section 4.1 shows tables indicating the percentage of households that meet certain threshold spending levels (e.g., > 6%) for the fraction of household income spent on household energy. These data are shown for each RECS year and Census Division.

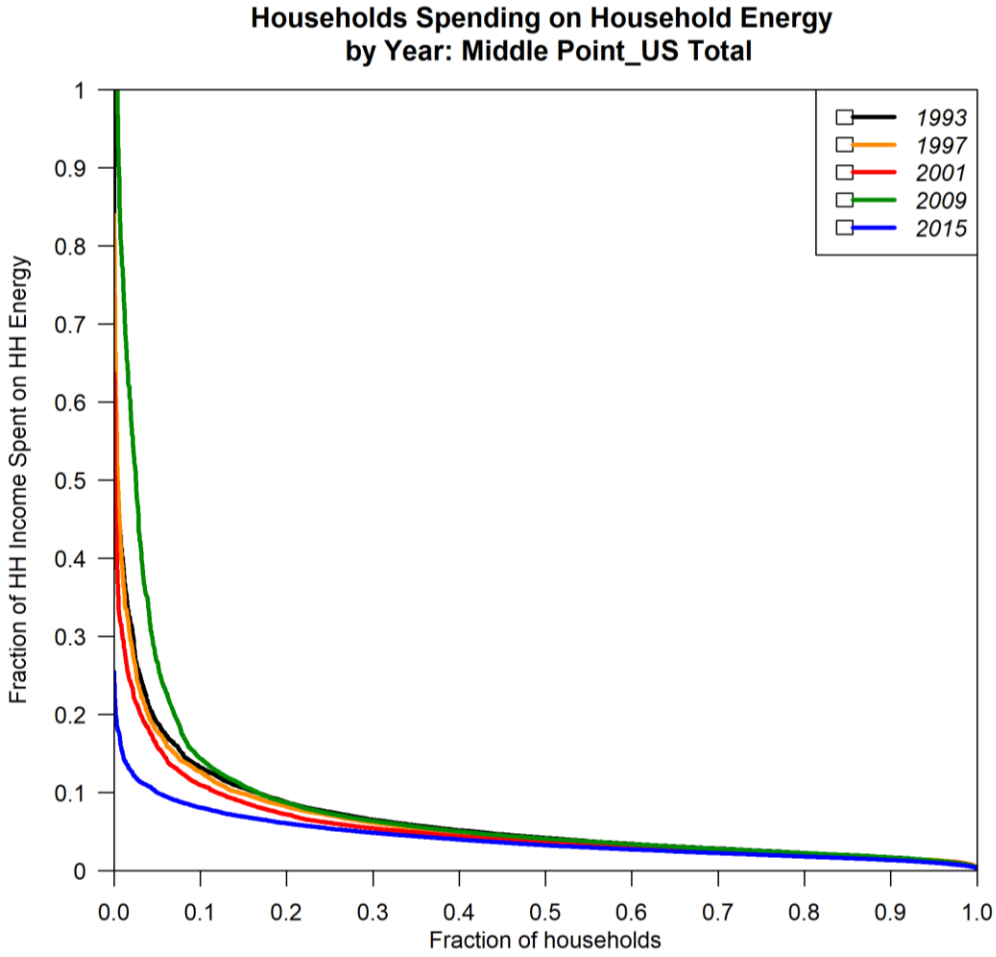

Figure 1. Households Spending on Household Energy of the U.S. by RECS Year (assuming the middle value within the household income brackets).

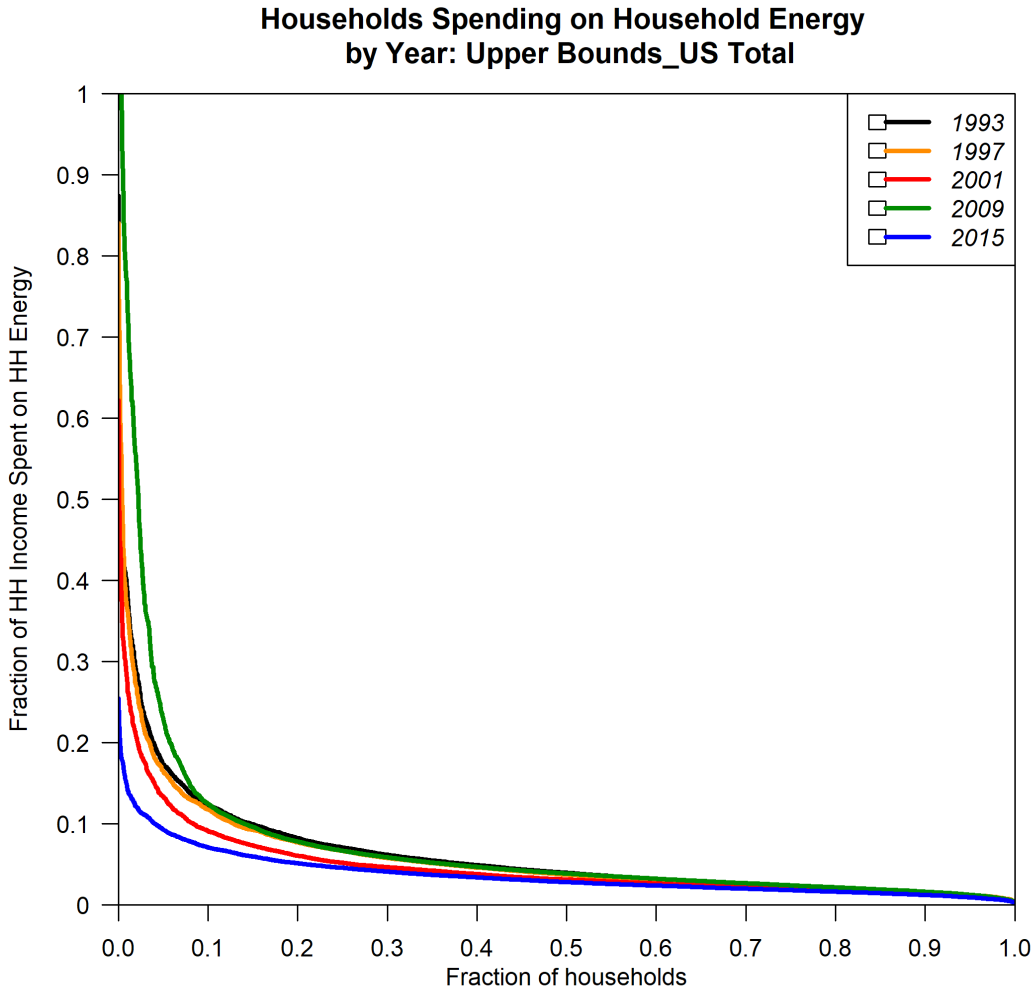

Figure 2. Households Spending on Household Energy of the U.S. by Year (assuming the upper bound value for each household income bracket).

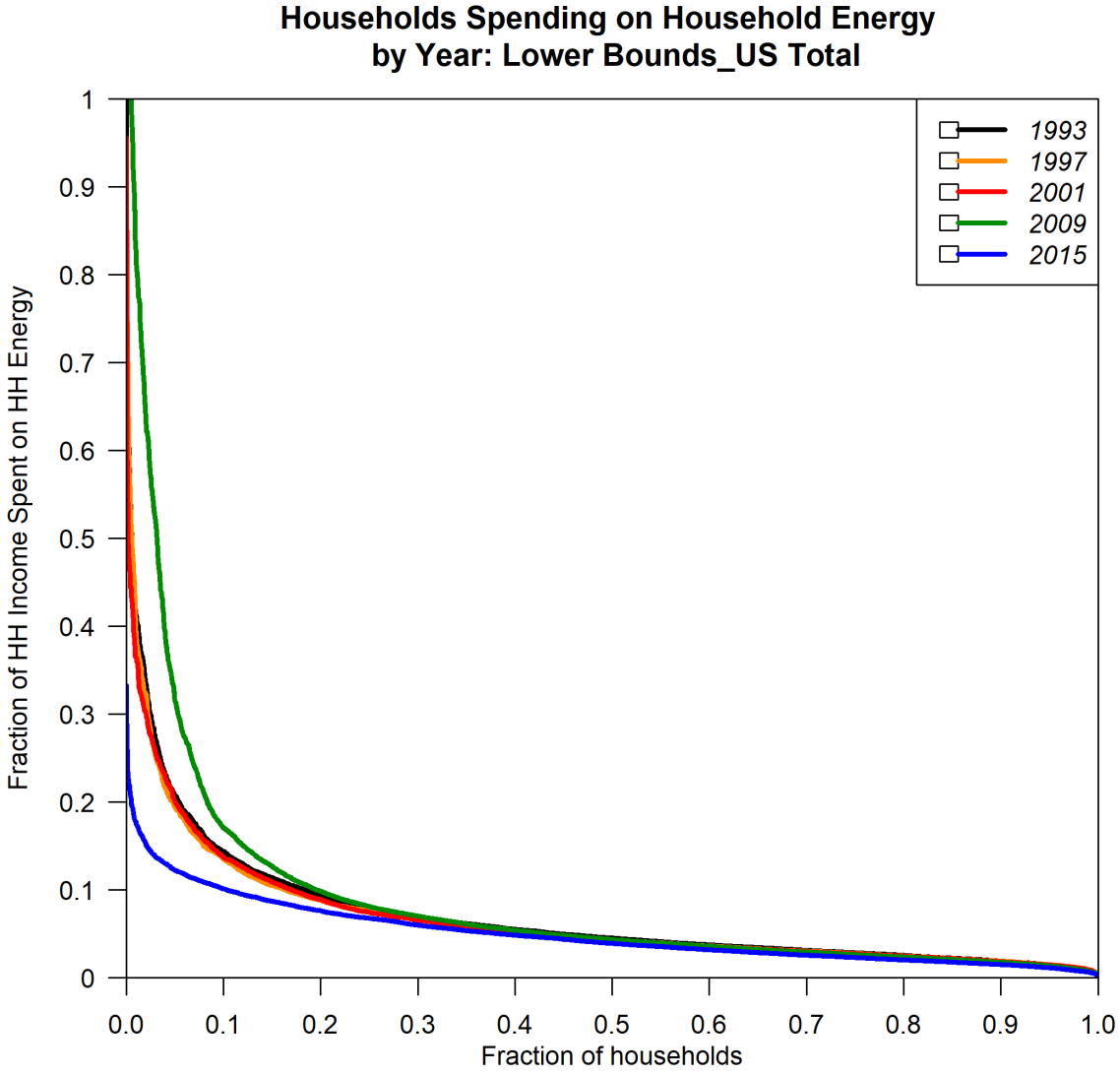

Figure 3. Households Spending on Household Energy of the U.S. by Year (assuming the lower bound value for each household income bracket).

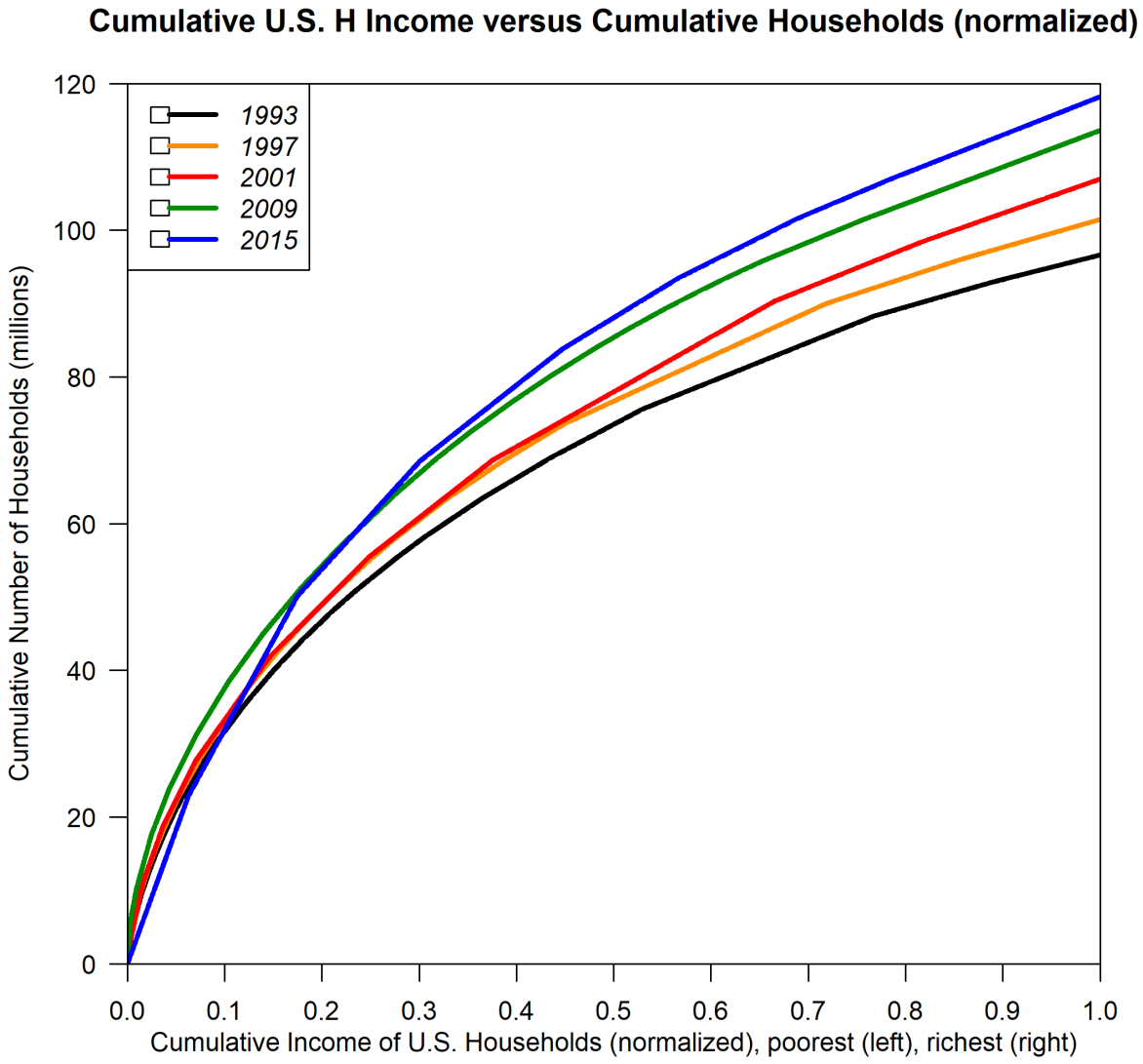

Figure 4. The cumulative number of households (by summing the NWEIGHT for each RECS survey entry) versus the cumulative U.S. household income (by summing the value of NWEIGHT×MONEYPY) normalized by the total income of all U.S. households. The data are ordered from left to right where the leftmost data are the lowest income households and the right most points are the highest income households.

4.1. Household Spending on Household Energy by Region and Income Assumption

This section summarizes the calculations of household spending on energy as a percentage of household income by both Census Division and the assumed household income (per Sections 2 and 3). For each RECS year, Figure 5 displays the fraction of households that spend more than the indicated threshold percentage of income on household energy. The error bars indicate the values calculated when assuming the three different income levels for each survey respondent. For example, for the 2001 data, approximately 37.3%, 44.2%, and 53.5% of U.S. households spend more than 4% of income on household energy if assuming the upper end, middle point, and lower end of the RECS income brackets for the survey. These values can be directly ascertained from Table 10, and Figure 5 is a plot of the data in Table 10 when considering all data for the U.S. For the same 2001 year, Table 10 and Figure 5 indicate that 75.5% of U.S. households spend more than 2% of income on household energy. Note that the 75.5% of U.S. households spending more than 2% of income on household energy *includes* the 44.2% of U.S. households spending more than 4% of income on household energy. Thus, it is not an error that these percentages sum to more than 100%. One can deduce from these values that 75.2% - 44.2% = 31% spend between 2% and 4% of household income on household energy.

Appendices C1 and C2 show similar data as Figure 5 for each Census Division.

The calculations in Table 10 and Appendix A indicate that households in the Pacific or Mountain (and Mountain South) Divisions tend to have lower household income on household energy every year.

One takeaway from Figure 5 and Table 10 is that the definitions of the income brackets translate to higher uncertainty for household spending on household energy in 2001 and 2015 relative to the other three years. This is mainly because the 2001 RECS used only ten income categories, and the RECS 2015 used only eight. On the other hand, the number of income categories in 1993 and 1997 is twenty-five, and there were twenty-four in 2009. Because of the wider range of income in 2001 and 2015 and smaller sample size (seeTable 2), the uncertainty of the ratio of households spending on household energy in 2001 and 2015 is larger than the other years. Also, as shown in Table 2, the 2009 RECS had a much larger sample size than other years, which translates to the year with the lowest uncertainty.

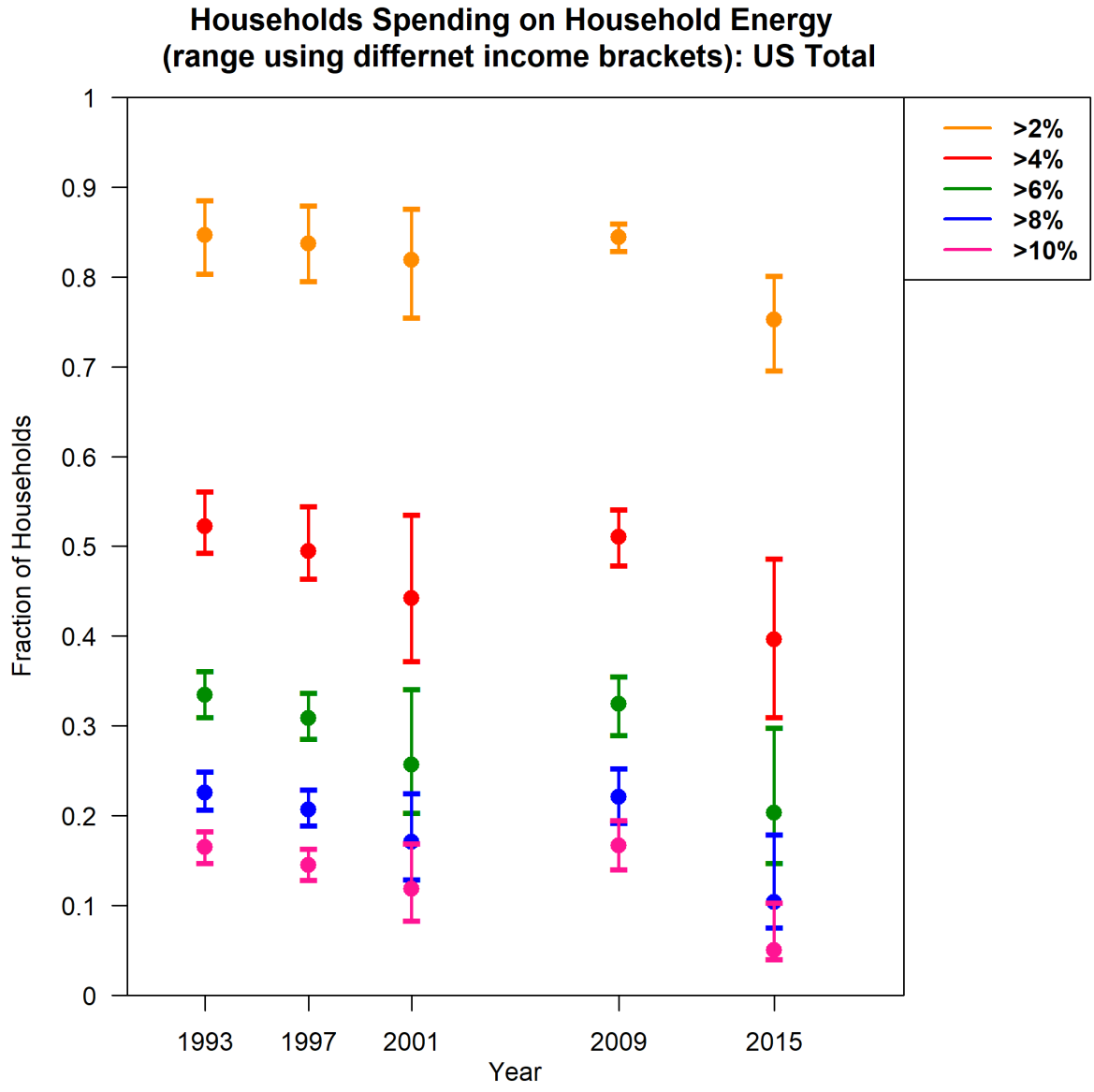

Figure 5. Household Spending on Household Energy, using data for all of the U.S., by "spending bracket". The expressed uncertainty is based solely on the assumption of the three different household incomes, and not by using the inherent sample error of the RECS.

Table 10. Percentage of households, per the U.S. overall and per Census Division, spending less than or more than the stated percentages of income on household energy for 1993 and 1997.

		% of population spending more than X% of income on household energy																	
Year	Cenus Division or Region	< 2%			>2%			>4%			>6%			>8%			>10%		
		Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower
1993	United States	15.4%	19.7%	11.5%	84.7%	80.4%	88.6%	52.2%	49.3%	56.1%	33.5%	31.0%	36.1%	22.5%	20.7%	24.9%	16.5%	14.7%	18.3%
	New England	12.5%	16.8%	8.3%	87.5%	83.2%	91.7%	54.1%	51.2%	59.2%	37.2%	35.3%	40.1%	25.3%	23.8%	27.9%	18.6%	16.6%	21.3%
	Middle Atlantic	11.3%	14.8%	8.7%	88.7%	85.2%	91.3%	56.2%	53.2%	61.5%	37.2%	35.2%	40.4%	28.1%	26.9%	30.2%	22.7%	20.9%	24.6%
	East North Central	11.4%	16.5%	7.1%	88.6%	83.5%	92.9%	55.3%	52.5%	60.1%	36.7%	33.4%	39.4%	24.2%	22.3%	26.8%	17.3%	14.8%	19.3%
	West North Central	9.3%	13.9%	6.5%	90.7%	86.1%	93.5%	58.9%	54.4%	62.6%	36.4%	34.0%	38.7%	25.2%	22.9%	28.1%	17.4%	16.2%	20.0%
	South Atlantic	12.8%	17.2%	8.8%	87.2%	82.8%	91.2%	53.5%	49.7%	57.3%	35.4%	32.7%	37.6%	22.2%	21.0%	24.5%	16.2%	14.5%	18.2%
	East South Central	14.0%	17.1%	9.4%	86.0%	82.9%	90.6%	57.6%	55.6%	60.9%	37.3%	35.4%	40.1%	26.7%	23.9%	30.7%	20.1%	17.7%	20.9%
	West South Central	7.6%	10.9%	4.7%	92.4%	89.1%	95.3%	61.3%	60.2%	66.0%	39.9%	37.9%	43.6%	26.9%	24.8%	29.2%	19.8%	18.1%	21.6%
	Mountain	19.5%	23.1%	15.1%	80.5%	76.9%	84.9%	49.7%	45.5%	52.5%	28.7%	25.3%	30.5%	17.3%	14.4%	19.2%	11.3%	9.6%	13.1%
	Mountain N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Mounstain S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Pacific	34.7%	40.0%	29.4%	65.3%	60.0%	70.6%	32.0%	29.8%	33.9%	17.1%	15.2%	19.4%	10.9%	8.4%	12.7%	7.0%	6.2%	7.9%
1997	United States	16.3%	20.5%	12.1%	83.7%	79.5%	87.9%	49.5%	46.4%	54.5%	30.9%	28.6%	33.7%	20.6%	18.9%	22.9%	14.5%	12.9%	16.4%
	New England	11.8%	15.7%	7.9%	88.2%	84.3%	92.1%	54.9%	51.7%	61.7%	32.6%	29.4%	36.0%	21.5%	19.3%	23.7%	14.2%	12.0%	17.3%
	Middle Atlantic	11.1%	13.8%	7.8%	88.9%	86.2%	92.2%	55.7%	51.3%	61.3%	37.3%	35.5%	40.2%	26.2%	25.2%	29.3%	19.7%	17.7%	22.6%
	East North Central	13.6%	19.0%	9.1%	86.4%	81.0%	90.9%	48.9%	45.9%	54.5%	30.7%	28.1%	32.7%	20.8%	18.7%	22.7%	14.3%	13.1%	15.9%
	West North Central	17.5%	23.1%	9.6%	82.5%	76.9%	90.4%	46.9%	44.3%	51.6%	29.5%	27.1%	33.1%	18.9%	16.8%	21.7%	13.3%	12.0%	14.8%
	South Atlantic	14.2%	18.0%	10.0%	85.8%	82.0%	90.0%	52.0%	49.0%	57.4%	31.2%	28.8%	34.1%	20.0%	18.1%	22.6%	14.4%	13.0%	15.8%
	East South Central	13.2%	18.2%	10.0%	86.8%	81.8%	90.0%	55.4%	53.2%	59.1%	38.8%	36.7%	40.9%	27.0%	23.9%	29.2%	19.6%	17.7%	21.1%
	West South Central	11.5%	16.0%	8.0%	88.5%	84.0%	92.0%	56.4%	53.0%	61.7%	35.1%	33.0%	39.4%	25.1%	23.6%	27.0%	17.3%	14.5%	20.0%
	Mountain	21.2%	26.0%	16.0%	78.8%	74.0%	84.0%	41.3%	39.5%	45.4%	24.9%	23.2%	26.9%	15.9%	14.1%	17.4%	10.6%	10.0%	11.7%
	Mountain N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Mounstain S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Pacific	30.3%	33.3%	26.2%	69.7%	66.7%	73.8%	36.5%	33.8%	40.0%	20.9%	18.6%	23.5%	12.8%	11.9%	14.6%	8.0%	6.8%	9.4%

Table 10. (continued) **Percentage of households, per the U.S. overall and per Census Division, spending less than or more than the stated percentages of income on household energy for 2001 and 2009.**

		% of population spending more than X% of income on household energy																	
Year	Cenus Division or Region	< 2%			>2%			>4%			>6%			>8%			>10%		
		Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower
2001	United States	18.2%	24.5%	12.4%	81.9%	75.5%	87.6%	44.2%	37.3%	53.5%	25.7%	20.4%	34.1%	17.1%	12.9%	22.5%	11.9%	8.3%	16.9%
	New England	13.4%	18.0%	8.7%	86.6%	82.0%	91.3%	50.7%	42.0%	59.7%	29.8%	23.6%	38.4%	18.1%	13.4%	26.1%	13.4%	10.9%	18.3%
	Middle Atlantic	13.5%	17.5%	9.9%	86.5%	82.5%	90.1%	50.5%	43.3%	60.4%	33.3%	27.2%	40.5%	22.5%	16.5%	28.9%	15.3%	10.5%	22.1%
	East North Central	16.9%	23.7%	10.2%	83.1%	76.3%	89.8%	43.1%	36.7%	53.9%	23.5%	18.0%	32.6%	15.5%	11.8%	20.0%	10.3%	7.2%	15.4%
	West North Central	11.1%	17.9%	7.2%	88.9%	82.1%	92.8%	47.8%	38.5%	56.8%	27.1%	21.7%	36.7%	20.1%	16.0%	23.8%	14.1%	9.9%	20.5%
	South Atlantic	15.6%	23.3%	11.0%	84.4%	76.7%	89.0%	44.3%	37.9%	53.4%	25.4%	19.8%	33.7%	16.4%	13.6%	22.4%	12.3%	9.4%	16.4%
	East South Central	14.6%	21.8%	8.6%	85.4%	78.2%	91.4%	52.4%	44.2%	60.2%	33.2%	26.2%	41.0%	23.1%	15.8%	29.5%	15.5%	11.6%	22.9%
	West South Central	13.7%	18.0%	7.0%	86.3%	82.0%	93.0%	53.3%	45.5%	62.0%	30.6%	25.9%	41.7%	22.3%	17.4%	27.6%	17.0%	10.3%	21.7%
	Mountain	15.6%	22.6%	10.4%	84.4%	77.4%	89.6%	43.0%	37.0%	54.4%	25.5%	19.7%	34.2%	17.3%	12.3%	22.3%	11.1%	7.9%	17.0%
	Mountain N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Mounstain S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Pacific	37.2%	44.7%	28.4%	62.8%	55.3%	71.6%	26.4%	20.8%	34.6%	12.9%	9.5%	19.5%	6.6%	4.3%	11.4%	3.4%	2.2%	6.6%
2009	United States	15.6%	17.1%	14.0%	84.4%	82.9%	86.0%	51.0%	47.9%	54.1%	32.4%	29.0%	35.5%	22.1%	19.2%	25.3%	16.6%	14.0%	19.5%
	New England	4.9%	5.2%	4.1%	95.1%	94.8%	95.9%	60.2%	57.3%	62.8%	37.0%	34.5%	39.9%	27.2%	24.9%	29.5%	21.5%	19.2%	23.9%
	Middle Atlantic	10.0%	11.2%	8.8%	90.0%	88.8%	91.2%	57.9%	55.3%	60.9%	39.0%	36.1%	42.0%	28.0%	25.2%	30.7%	21.2%	17.5%	24.2%
	East North Central	10.7%	12.4%	9.1%	89.3%	87.6%	90.9%	53.1%	49.8%	57.1%	33.5%	29.9%	36.5%	23.4%	21.5%	26.6%	19.2%	16.6%	21.9%
	West North Central	15.9%	18.4%	14.1%	84.1%	81.6%	85.9%	48.9%	44.8%	51.9%	28.4%	24.8%	32.9%	18.9%	15.9%	22.3%	13.5%	10.5%	16.6%
	South Atlantic	12.2%	13.2%	10.7%	87.8%	86.8%	89.3%	55.3%	52.5%	58.0%	36.0%	31.2%	39.1%	23.2%	19.3%	27.1%	16.4%	13.9%	19.8%
	East South Central	8.8%	9.7%	8.0%	91.2%	90.3%	92.0%	59.1%	56.2%	62.0%	39.7%	36.2%	42.5%	29.2%	26.3%	32.4%	23.5%	21.2%	26.7%
	West South Central	10.1%	11.1%	8.8%	89.9%	88.9%	91.2%	59.4%	56.1%	62.1%	38.3%	34.1%	42.9%	25.4%	21.7%	29.1%	19.1%	16.2%	22.4%
	Mountain	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Mountain N	22.6%	24.2%	20.1%	77.4%	75.8%	79.9%	38.1%	32.8%	43.5%	20.5%	17.9%	22.0%	12.6%	11.2%	16.6%	9.3%	6.7%	11.8%
	Mounstain S	18.0%	18.6%	17.2%	82.0%	81.4%	82.8%	45.6%	41.1%	49.8%	27.9%	26.3%	29.1%	19.3%	15.6%	23.1%	12.4%	9.4%	15.9%
	Pacific	38.2%	41.4%	35.7%	61.8%	58.6%	64.3%	29.6%	27.1%	32.1%	17.5%	15.5%	20.0%	10.9%	9.0%	13.1%	8.0%	6.5%	9.9%

Table 10. (continued) **Percentage of households, per the U.S. overall and per Census Division, spending less than or more than the stated percentages of income on household energy for 2015.**

		% of population spending more than X% of income on household energy																	
Year	Cenus Division or Region	< 2%			>2%			>4%			>6%			>8%			>10%		
		Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower
2015	United States	24.8%	30.4%	19.9%	75.2%	69.6%	80.1%	39.6%	31.0%	48.7%	20.3%	14.8%	29.8%	10.3%	7.5%	17.9%	5.0%	4.1%	10.3%
	New England	9.6%	11.8%	5.8%	90.4%	88.2%	94.2%	55.8%	46.4%	63.2%	32.9%	26.5%	42.5%	21.0%	14.6%	30.1%	14.4%	12.0%	22.1%
	Middle Atlantic	21.3%	26.2%	17.6%	78.7%	73.8%	82.4%	47.2%	37.2%	53.2%	25.1%	19.8%	34.4%	14.0%	10.0%	20.2%	7.7%	5.9%	13.5%
	East North Central	24.8%	31.5%	19.5%	75.2%	68.5%	80.5%	37.9%	28.4%	47.3%	18.4%	12.2%	29.4%	8.4%	5.9%	18.2%	3.5%	2.8%	10.1%
	West North Central	23.7%	30.6%	18.4%	76.3%	69.4%	81.6%	36.2%	24.6%	47.8%	16.1%	12.6%	26.9%	6.1%	4.7%	12.2%	1.6%	1.4%	5.0%
	South Atlantic	19.6%	25.8%	15.5%	80.4%	74.2%	84.5%	42.0%	34.2%	52.3%	23.0%	15.8%	31.2%	11.9%	8.6%	20.2%	5.7%	4.1%	11.5%
	East South Central	10.1%	12.9%	7.8%	89.9%	87.1%	92.2%	59.8%	49.0%	71.7%	32.7%	24.4%	47.3%	18.5%	15.1%	29.6%	8.0%	7.5%	16.5%
	West South Central	23.9%	28.7%	19.0%	76.1%	71.3%	81.0%	41.3%	31.1%	49.9%	19.9%	13.4%	33.5%	9.8%	7.3%	19.7%	4.1%	3.5%	9.8%
	Mountain	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Mountain N	36.1%	40.5%	27.4%	63.9%	59.5%	72.6%	24.7%	19.7%	33.4%	11.3%	8.4%	19.9%	4.9%	2.9%	10.5%	1.0%	1.0%	4.2%
	Mounstain S	21.9%	28.0%	15.6%	78.1%	72.0%	84.4%	42.6%	36.2%	52.1%	23.2%	19.9%	31.8%	12.3%	9.7%	17.9%	7.8%	6.5%	11.6%
	Pacific	44.3%	51.3%	37.7%	55.7%	48.7%	62.3%	21.4%	16.1%	29.8%	9.3%	6.4%	13.9%	3.5%	2.7%	7.2%	1.7%	1.7%	4.2%

4.2 Household Spending on Household Energy by Energy Carrier

Table 11 and Table 12 provide household energy spending data per energy carrier. Table 11shows the percentage of households, per the U.S. and each Census Division, that spend less than 2% of income on household consumption of electricity, natural gas, LPG, and fuel oil. Table 12 shows the same data except expressed as the opposite percentage of households spending more than 2% of income on each energy carrier. One obtains a value of 100% by adding a given data value in Table 11 to that in Table 12. Thus, these tables allow one to see which Census Divisions have households that spend significant amounts on electricity, natural gas, LPG, and fuel oil.

The data show that electricity and natural gas are the dominant energy expense for most households. Practically 100% of U.S. households consume electricity and the vast majority have access to natural gas. The U.S. total shows that less than 5% of households spend more than 2% of income on fuel oil or LPG. Only the Middle Atlantic and New England divisions have significant numbers of households spending more than 2% of household energy on fuel oil or LPG, with higher expenditures for fuel oil than LPG. For New England and Middle Atlantic respectively, generally over 20% and 10% of households spend more than 2% of income on fuel oil. These data reflect that homes in these regions both have cold winters and less access to natural gas than other regions of the country.

Table 11. Percentage of households spending less than 2% of income on household energy for each energy source in the U.S. overall as well as per Census Division.

Cenus Division or Region	Year	% of population spending less than 2% of income on household energy											
		<2%											
		Electricity			Natural Gas			Fuel Oil			LPG		
		Mid	Upper	Lower	Mid	Mid	Mid	Mid	Mid	Mid	Mid	Upper	Lower
United States	1993	36.2%	39.7%	31.9%	73.7%	75.2%	72.0%	95.3%	95.6%	95.6%	96.4%	96.6%	96.1%
	1997	39.3%	43.3%	34.5%	75.5%	77.1%	73.8%	95.0%	95.3%	95.3%	96.8%	97.0%	96.7%
	2001	43.9%	51.3%	35.9%	76.2%	80.3%	71.2%	96.9%	97.4%	97.4%	96.7%	97.2%	96.1%
	2009	36.8%	39.2%	34.3%	78.0%	79.4%	76.4%	96.2%	96.4%	96.4%	95.6%	95.8%	95.3%
	2015	42.0%	49.3%	34.4%	88.7%	91.9%	83.8%	97.1%	97.4%	97.4%	97.9%	98.2%	97.3%
New England	1993	46.1%	49.4%	41.2%	78.9%	80.1%	76.9%	75.4%	77.6%	77.6%	97.5%	97.6%	97.3%
	1997	47.8%	52.0%	43.1%	80.8%	83.1%	79.2%	72.3%	74.8%	74.8%	98.5%	98.5%	98.4%
	2001	54.9%	61.7%	47.1%	77.2%	80.6%	73.7%	76.8%	81.1%	81.1%	97.4%	97.8%	97.0%
	2009	44.6%	46.8%	42.3%	71.4%	72.9%	70.6%	73.7%	74.7%	74.7%	96.7%	96.8%	96.3%
	2015	44.5%	49.8%	35.1%	80.0%	84.2%	75.7%	73.6%	75.8%	75.8%	93.8%	94.3%	93.7%
Middle Atlantic	1993	41.2%	44.5%	37.3%	62.9%	65.1%	59.9%	86.4%	87.5%	87.5%	99.3%	99.3%	99.2%
	1997	42.0%	46.7%	37.3%	65.6%	68.9%	63.7%	82.6%	83.6%	83.6%	99.2%	99.2%	99.2%
	2001	46.4%	53.2%	39.0%	66.0%	70.6%	59.8%	90.6%	91.8%	91.8%	99.1%	99.2%	98.8%
	2009	41.5%	44.4%	39.2%	65.3%	67.0%	63.8%	85.5%	86.3%	86.3%	96.4%	96.4%	96.3%
	2015	49.4%	54.8%	40.8%	80.5%	85.2%	74.3%	90.3%	91.9%	91.9%	97.7%	98.1%	97.2%
East North Central	1993	41.9%	45.8%	36.9%	57.3%	59.5%	55.2%	98.0%	98.0%	98.0%	95.7%	95.9%	95.5%
	1997	49.3%	53.9%	44.3%	61.8%	63.2%	57.9%	98.2%	98.2%	98.2%	96.1%	96.5%	95.8%
	2001	56.2%	63.2%	45.0%	65.0%	71.4%	56.6%	99.1%	99.1%	99.1%	97.0%	97.5%	96.6%
	2009	42.6%	45.9%	38.4%	61.4%	63.4%	59.3%	98.6%	98.7%	98.7%	95.0%	95.0%	94.9%
	2015	47.1%	58.3%	37.7%	79.2%	86.4%	73.0%	99.8%	99.8%	99.8%	98.2%	98.8%	97.4%
West North Central	1993	35.4%	39.0%	32.1%	69.7%	71.8%	67.0%	95.9%	96.1%	96.1%	90.7%	91.8%	89.9%
	1997	48.2%	52.3%	43.6%	72.2%	75.0%	71.2%	96.2%	96.4%	96.4%	91.6%	91.6%	91.5%
	2001	51.0%	57.3%	40.7%	72.5%	75.4%	66.6%	96.2%	97.0%	97.0%	90.8%	91.9%	89.3%
	2009	45.5%	48.7%	42.0%	73.3%	76.0%	71.3%	98.5%	98.5%	98.5%	89.8%	90.1%	89.6%
	2015	46.1%	54.9%	37.4%	85.9%	90.4%	79.1%	99.7%	99.7%	99.7%	97.6%	97.7%	97.1%
South Atlantic	1993	23.1%	27.3%	18.1%	85.8%	86.3%	84.8%	97.4%	97.5%	97.5%	95.5%	95.7%	95.0%
	1997	27.3%	31.0%	22.2%	84.2%	85.0%	83.6%	97.9%	98.1%	98.1%	96.7%	96.9%	96.6%
	2001	30.9%	40.5%	24.4%	85.9%	88.1%	81.9%	99.1%	99.4%	99.4%	96.2%	97.0%	95.7%
	2009	22.2%	23.8%	20.5%	88.9%	89.4%	88.0%	98.7%	98.8%	98.8%	96.9%	97.3%	96.7%
	2015	30.1%	37.7%	23.7%	93.8%	95.2%	90.7%	98.7%	98.8%	98.8%	98.3%	98.4%	97.5%

Table 11. (continued) **Percentage of households spending less than 2% of income on household energy for each energy source per Census division.**

Cenus Division or Region	Year	% of population spending less than 2% of income on household energy											
		<2%											
		Electricity			Natural Gas			Fuel Oil			LPG		
		Mid	Upper	Lower	Mid	Mid	Mid	Mid	Mid	Mid	Mid	Upper	Lower
East South Central	1993	22.9%	26.5%	18.4%	80.6%	81.8%	80.3%	99.0%	99.0%	99.0%	91.9%	92.3%	91.7%
	1997	24.7%	28.1%	21.4%	81.2%	81.8%	80.3%	99.8%	99.8%	99.8%	92.4%	92.4%	92.2%
	2001	27.0%	35.7%	20.6%	83.3%	86.2%	80.1%	99.8%	99.8%	99.8%	91.8%	93.4%	90.1%
	2009	19.4%	20.9%	17.8%	86.0%	86.6%	84.7%	100.0%	100.0%	100.0%	91.4%	91.4%	91.0%
	2015	15.7%	21.2%	12.2%	89.8%	92.5%	85.3%	99.5%	99.5%	99.5%	96.9%	97.3%	96.3%
West South Central	1993	19.2%	22.2%	15.5%	71.2%	72.7%	69.7%	100.0%	100.0%	100.0%	97.8%	98.4%	97.2%
	1997	24.5%	28.3%	17.6%	74.2%	75.7%	73.1%	100.0%	100.0%	100.0%	97.5%	97.6%	97.5%
	2001	25.0%	30.6%	17.5%	76.3%	80.9%	71.9%	100.0%	100.0%	100.0%	98.6%	98.7%	98.4%
	2009	18.9%	20.1%	17.0%	82.2%	83.5%	80.7%	100.0%	100.0%	100.0%	96.8%	97.0%	96.4%
	2015	31.6%	37.9%	25.2%	95.5%	97.1%	90.6%	100.0%	100.0%	100.0%	99.2%	99.5%	98.7%
Mountain	1993	42.7%	46.4%	38.7%	74.5%	76.0%	71.5%	99.1%	99.1%	99.1%	95.5%	95.6%	95.2%
	1997	44.8%	48.0%	42.0%	80.3%	82.4%	78.9%	99.7%	99.7%	99.7%	97.1%	97.1%	96.6%
	2001	42.4%	51.5%	35.5%	72.0%	78.1%	67.3%	100.0%	100.0%	100.0%	95.1%	95.6%	94.5%
	2009	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mountain N	1993	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1997	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2001	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2009	59.9%	63.4%	56.9%	78.8%	80.7%	77.2%	100.0%	100.0%	100.0%	92.7%	92.9%	92.7%
	2015	63.7%	71.8%	54.3%	90.5%	93.7%	81.2%	100.0%	100.0%	100.0%	97.3%	97.3%	96.7%
Mounstain S	1993	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1997	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2001	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2009	31.0%	33.0%	29.3%	85.4%	88.0%	83.6%	100.0%	100.0%	100.0%	95.7%	95.9%	95.2%
	2015	36.5%	42.6%	26.4%	92.9%	93.8%	86.6%	100.0%	100.0%	100.0%	94.7%	94.7%	93.2%
Pacific	1993	51.8%	54.6%	47.9%	86.7%	87.8%	86.0%	99.0%	99.0%	99.0%	98.8%	98.8%	98.8%
	1997	47.6%	51.0%	43.1%	85.4%	86.5%	83.7%	99.3%	99.4%	99.4%	98.7%	98.7%	98.5%
	2001	59.4%	65.7%	51.6%	85.1%	88.6%	82.1%	99.8%	99.8%	99.8%	98.4%	98.7%	97.8%
	2009	55.9%	58.8%	53.5%	88.5%	89.8%	86.5%	99.7%	99.8%	99.8%	97.5%	97.8%	97.2%
	2015	58.3%	64.2%	51.2%	95.3%	97.2%	92.6%	99.6%	99.7%	99.7%	99.3%	99.4%	98.8%

Table 12. Percentage of households spending more than 2% of income on household energy for each energy source in U.S. total and Census Division.

Cenus Division or Region	Year	% of population spending more than X% of income on household energy											
		>2%											
		Electricity			Natural Gas			Fuel Oil			LPG		
		Mid	Upper	Lower	Mid	Mid	Mid	Mid	Mid	Mid	Mid	Upper	Lower
United States	1993	63.8%	60.3%	68.1%	26.3%	24.8%	28.0%	4.7%	4.4%	4.4%	3.6%	3.4%	3.9%
	1997	60.7%	56.7%	65.5%	24.5%	22.9%	26.2%	5.0%	4.7%	4.7%	3.2%	3.0%	3.3%
	2001	56.1%	48.7%	64.1%	23.8%	19.7%	28.8%	3.1%	2.6%	2.6%	3.3%	2.8%	3.9%
	2009	63.2%	60.8%	65.7%	22.0%	20.6%	23.6%	3.8%	3.6%	3.6%	4.4%	4.2%	4.7%
	2015	58.0%	50.7%	65.6%	11.3%	8.1%	16.2%	2.9%	2.6%	2.6%	2.1%	1.8%	2.7%
New England	1993	53.9%	50.6%	58.8%	21.1%	19.9%	23.1%	24.6%	22.4%	22.4%	2.5%	2.4%	2.7%
	1997	52.2%	48.0%	56.9%	19.2%	16.9%	20.8%	27.7%	25.2%	25.2%	1.5%	1.5%	1.6%
	2001	45.1%	38.3%	52.9%	22.8%	19.4%	26.3%	23.2%	18.9%	18.9%	2.6%	2.2%	3.0%
	2009	55.4%	53.2%	57.7%	28.6%	27.1%	29.4%	26.3%	25.3%	25.3%	3.3%	3.2%	3.7%
	2015	55.5%	50.2%	64.9%	20.0%	15.8%	24.3%	26.4%	24.2%	24.2%	6.2%	5.7%	6.3%
Middle Atlantic	1993	58.8%	55.5%	62.7%	37.1%	34.9%	40.1%	13.6%	12.5%	12.5%	0.7%	0.7%	0.8%
	1997	58.0%	53.3%	62.7%	34.4%	31.1%	36.3%	17.4%	16.4%	16.4%	0.8%	0.8%	0.8%
	2001	53.6%	46.8%	61.0%	34.0%	29.4%	40.2%	9.4%	8.2%	8.2%	0.9%	0.8%	1.2%
	2009	58.5%	55.6%	60.8%	34.7%	33.0%	36.2%	14.5%	13.7%	13.7%	3.6%	3.6%	3.7%
	2015	50.6%	45.2%	59.2%	19.5%	14.8%	25.7%	9.7%	8.1%	8.1%	2.3%	1.9%	2.8%
East North Central	1993	58.1%	54.2%	63.1%	42.7%	40.5%	44.8%	2.0%	2.0%	2.0%	4.3%	4.1%	4.5%
	1997	50.7%	46.1%	55.7%	38.2%	36.8%	42.1%	1.8%	1.8%	1.8%	3.9%	3.5%	4.2%
	2001	43.8%	36.8%	55.0%	35.0%	28.6%	43.4%	0.9%	0.9%	0.9%	3.0%	2.5%	3.4%
	2009	57.4%	54.1%	61.6%	38.6%	36.6%	40.7%	1.4%	1.3%	1.3%	5.0%	5.0%	5.1%
	2015	52.9%	41.7%	62.3%	20.8%	13.6%	27.0%	0.2%	0.2%	0.2%	1.8%	1.2%	2.6%
West North Central	1993	64.6%	61.0%	67.9%	30.3%	28.2%	33.0%	4.1%	3.9%	3.9%	9.3%	8.2%	10.1%
	1997	51.8%	47.7%	56.4%	27.8%	25.0%	28.8%	3.8%	3.6%	3.6%	8.4%	8.4%	8.5%
	2001	49.0%	42.7%	59.3%	27.5%	24.6%	33.4%	3.8%	3.0%	3.0%	9.2%	8.1%	10.7%
	2009	54.5%	51.3%	58.0%	26.7%	24.0%	28.7%	1.5%	1.5%	1.5%	10.2%	9.9%	10.4%
	2015	53.9%	45.1%	62.6%	14.1%	9.6%	20.9%	0.3%	0.3%	0.3%	2.4%	2.3%	2.9%
South Atlantic	1993	76.9%	72.7%	81.9%	14.2%	13.7%	15.2%	2.6%	2.5%	2.5%	4.5%	4.3%	5.0%
	1997	72.7%	69.0%	77.8%	15.8%	15.0%	16.4%	2.1%	1.9%	1.9%	3.3%	3.1%	3.4%
	2001	69.1%	59.5%	75.6%	14.1%	11.9%	18.1%	0.9%	0.6%	0.6%	3.8%	3.0%	4.3%
	2009	77.8%	76.2%	79.5%	11.1%	10.6%	12.0%	1.3%	1.2%	1.2%	3.1%	2.7%	3.3%
	2015	69.9%	62.3%	76.3%	6.2%	4.8%	9.3%	1.3%	1.2%	1.2%	1.7%	1.6%	2.5%

Table 12. (continued) **Percentage of households spending more than 2% of income on household energy for each energy source per Census Division.**

Cenus Division or Region	Year	% of population spending more than 2% of income on household energy											
		>2%											
		Electricity			Natural Gas			Fuel Oil			LPG		
		Mid	Upper	Lower	Mid	Mid	Mid	Mid	Mid	Mid	Mid	Upper	Lower
East South Central	1993	77.1%	73.5%	81.6%	19.4%	18.2%	19.7%	1.0%	1.0%	1.0%	8.1%	7.7%	8.3%
	1997	75.3%	71.9%	78.6%	18.8%	18.2%	19.7%	0.2%	0.2%	0.2%	7.6%	7.6%	7.8%
	2001	73.0%	64.3%	79.4%	16.7%	13.8%	19.9%	0.2%	0.2%	0.2%	8.2%	6.6%	9.9%
	2009	80.6%	79.1%	82.2%	14.0%	13.4%	15.3%	0.0%	0.0%	0.0%	8.6%	8.6%	9.0%
	2015	84.3%	78.8%	87.8%	10.2%	7.5%	14.7%	0.5%	0.5%	0.5%	3.1%	2.7%	3.7%
West South Central	1993	80.8%	77.8%	84.5%	28.8%	27.3%	30.3%	0.0%	0.0%	0.0%	2.2%	1.6%	2.8%
	1997	75.5%	71.7%	82.4%	25.8%	24.3%	26.9%	0.0%	0.0%	0.0%	2.5%	2.4%	2.5%
	2001	75.0%	69.4%	82.5%	23.7%	19.1%	28.1%	0.0%	0.0%	0.0%	1.4%	1.3%	1.6%
	2009	81.1%	79.9%	83.0%	17.8%	16.5%	19.3%	0.0%	0.0%	0.0%	3.2%	3.0%	3.6%
	2015	68.4%	62.1%	74.8%	4.5%	2.9%	9.4%	0.0%	0.0%	0.0%	0.8%	0.5%	1.3%
Mountain	1993	57.3%	53.6%	61.3%	25.5%	24.0%	28.5%	0.9%	0.9%	0.9%	4.5%	4.4%	4.8%
	1997	55.2%	52.0%	58.0%	19.7%	17.6%	21.1%	0.3%	0.3%	0.3%	2.9%	2.9%	3.4%
	2001	57.6%	48.5%	64.5%	28.0%	21.9%	32.7%	0.0%	0.0%	0.0%	4.9%	4.4%	5.5%
	2009	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mountain N	1993	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1997	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2001	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2009	40.1%	36.6%	43.1%	21.2%	19.3%	22.8%	0.0%	0.0%	0.0%	7.3%	7.1%	7.3%
	2015	36.3%	28.2%	45.7%	9.5%	6.3%	18.8%	0.0%	0.0%	0.0%	2.7%	2.7%	3.3%
Mounstain S	1993	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1997	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2001	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2009	69.0%	67.0%	70.7%	14.6%	12.0%	16.4%	0.0%	0.0%	0.0%	4.3%	4.1%	4.8%
	2015	63.5%	57.4%	73.6%	7.1%	6.2%	13.4%	0.0%	0.0%	0.0%	5.3%	5.3%	6.8%
Pacific	1993	48.2%	45.4%	52.1%	13.3%	12.2%	14.0%	1.0%	1.0%	1.0%	1.2%	1.2%	1.2%
	1997	52.4%	49.0%	56.9%	14.6%	13.5%	16.3%	0.7%	0.6%	0.6%	1.3%	1.3%	1.5%
	2001	40.6%	34.3%	48.4%	14.9%	11.4%	17.9%	0.2%	0.2%	0.2%	1.6%	1.3%	2.2%
	2009	44.1%	41.2%	46.5%	11.5%	10.2%	13.5%	0.3%	0.2%	0.2%	2.5%	2.2%	2.8%
	2015	41.7%	35.8%	48.8%	4.7%	2.8%	7.4%	0.4%	0.3%	0.3%	0.7%	0.6%	1.2%

Summary

This white paper summarizes calculations for United States spending on household energy as a fraction (or percentage) of household income. It uses data from the Energy Information Administration Residential Energy Consumption Surveys for the years 1993, 1997, 2001, 2009, and 2015. The data indicate difficulties in comparing survey data on energy spending across the survey years, particularly the last three survey years of 2005 (with no reported income data), 2009 with higher levels of reported energy spending for the 10% of households with the highest energy spending per income, and 2015 that indicates much lower energy spending per household income than all other survey years.

References

Energy Information Administration (EIA) Residential Energy Consumption Survey (RECS) data. Accessible at https://www.eia.gov/consumption/residential/.

EIA (2015) "One in three U.S. households faced challenges in paying energy bills in 2015", accessible February 12, 2020 at https://www.eia.gov/consumption/residential/reports/2015/energybills/.

Data and Code Files

The data files and R codes used to perform the calculations and create figures and Tables in this report are available on Dr. Carey King's website via his "Data" subpage: http://careyking.com/data-downloads/.